DOCUMENT RESUME

ED 135 610 SE 021 974

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TITLE Development of College/Industry Partnerships.
PUB DATE Feb 76
NOTE 12p.; Paper presented at the annual meeting of the American Association for the Advancement of Science (Boston, Massachusetts, February 22-23, 1976); Not available in hard copy due to marginal legibility of original document

EDRS PRICE MF-$0.83 Plus Postage. HC Not Available from EDRS.
DESCRIPTORS *Engineering Education; *Higher Education; *Industry; Internship Programs; *Program Descriptions; *School Industry Relationship; Technology; Undergraduate Study

ABSTRACT

Described is the College of Engineering educational program at the University of Detroit which emphasizes interaction between students, faculty, and industry. The undergraduate pre-professional and professional programs as well as the three-phase doctor of engineering program which includes an internship are outlined. (SL)

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# DEVELOPMENT OF COLLEGE/INDUSTRY PARTNERSHIPS

by

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invited presentation at the

AAAS Annual Meeting

"Science and Our Expectations: Bicentennial and Beyond"

Boston, Massachusetts

February 18, 1976

Program on

Putting Science to Work through University/Industry Interaction

SE 021 974

The importance of interaction at the academia-industry interface is widely recognized today. The focus of recent conferences, seminars and symposia (1, 2, 3) has been on this problem, with views expressed from both sides of the fence. The reasons for this recent thrust to enhance the relationships between the industrial community and the nation's colleges and universities are many, but at least three are worth noting here.

1. The goals of academia and industry are closer today; different from the historical posture of counter goals, mutual mistrust, and contempt.

2. There is a recognition of the need in academia to relate more closely with the complex problems of development, design, finance, production and social acceptance; and the artful means used to deal with these problems.

3. There is a need in industry to maintain close liaison with sources of talent, scientific and technological developments, and the social inventiveness existing in academia.

A half century ago the academic community and the liberally educated were antagonists of the industrial system. Capital was the lifeblood of industry and small technological advances could be converted into major markets, large production demand and maximization of profits. Academia and the liberally educated were not responsive to pecuniary motivation and were looked upon with disdain by the entrepreneurs. Social reform and technological development, however, grew together and the role of academia became more prominant, the industrial complex more responsive to the needs of society, and a common ground has now developed on which academia and industry can interact to produce positive results.

Capital is no longer the major lifeblood of industry. The college trained mind is now vital to the maintenance and future development of the industrial complex. The modern scholar of science, engineering and business must guide industry through the besetting problems of communication, transportation, production, etc.

It is absurd today to think of the liberally educated having little knowledge of interest in science, technology and business. These are here to stay and must be dealt with by all to develop understanding and a rational basis for the decisions of society. Just as business and engineering colleges have recognized the need for in-

depth exposure of their students to humanities and social sciences, the liberal arts student must recognize that his ability to function effectively will be substantially diminished without some fundamental understanding of science, technology and business.

With this background it becomes clear that industry and universities should form partnerships to jointly manage and develop one of the nation's most important resources: its scientific and technical manpower.

The following will briefly explain some aspects of the Industry/University partnerships being developed at the University of Detroit. Focus will be on the College of Engineering; however, the concept of interaction between the students, faculty and the professional world of work is rapidly developing in the College of Arts and Sciences, the College of Business and Administration, and the School of Law. The development of a professional practice orientation in the School of Architecture parallels somewhat the programs in Engineering.

The framework for this partnership is a five-year cooperative engineering bachelor's program and the professionally oriented Doctor of Engineering program.

The key features of the bachelor's program (Figure 1) are an in-depth study of the social and humanistic areas, a twelve month work experience spaced over three four month periods in the student's upper division program, seminars on the professional world of work, an interdisciplinary approach to the engineering sciences, and an interdisciplinary design course which spans twelve months.

All students must spend approximately one year studying in the humanities and social sciences. One area of interest is pursued in depth and represents a minor area of study for the engineering student. To help motivate and inform the students in selecting humanities and social science areas of study, the freshmen take part in a program on Man, Technology and Society where the impact that technology has on society is explored. Cross-disciplinary introduction courses are also available for freshmen engineers from the Arts and Science Faculty. The engineering sciences are taught in a college core uniformly to all the engineering students. The twelve month cooperative training program places students in industry, government or private practice nationwide to gain experience in the application of technology and interface with organizational structures, work policies, and practitioners. The technical as well as the non-technical aspects of cooperative training receive attention.

3.

PRE PROFESSIONAL

MATHEMATICS

SCIENCES

COMMUNICATION SKILLS

ENGINEERING SCIENCES

PROFESSIONAL

ANALYSIS

SYNTHESIS

DESIGN

CHEMICAL

CIVIL

ELECTRICAL

MECHANICAL

OTHERS

CONCEPTUAL SKILLS

TECHNICAL COMPETENCE

HUMAN RELATIONS SKILLS

HUMANITIES AND SOCIAL SCIENCES

COOPERATIVE TRAINING AND PROFESSIONAL WORLD OF WORK

ART

PRACTICE

ETHICAL VALUES

PROFESSIONAL RESPONSIBILITY

Figure 1

The seminars on the Professional World of Work take place when the students return from each cooperative training assignment. In these seminars a small group of students interact with a faculty member, a placement coordinator and an executive from industry to discuss non-technical issues. The students are asked to be perceptive about particular issues while out on the job and to return ready to discuss them. Some of the issues discussed are, professionalism at work; problems with technical obsolescence of the work force; the role of the company in social reform; political influence; how and why ideas are accepted or rejected; how communications are handled; corporate policies and the general interest of society. Participation by top level people from industry in these seminars serves two very important purposes. First, it gives the student an opportunity to discuss these issues face to face with an influential member of the corporate structure. The student learns quickly about the expectations of the employer, the corporate policies, and why these policies exist. He can also challenge them from his own point of view. Secondly, the corporate executive learns first hand about the expectation of the modern student aspiring to an influential role in industry and society. He also observes the resources in the school and faculty, and has an opportunity to present his point of view, and provide input to the problem of developing good education.

Design is important in the undergraduate program and students should be able to use the fundamental principles learned in mathematics, science, and the engineering sciences to design functional systems using some innovation and gaining some knowledge of standard practice. This discipline oriented design challenges the student's technical competence and to some extent his organizational skill. But there is a need to go beyond this. It is important to gain some insight into how a project is conceived, why it is necessary, and who establishes the need. Then in addition to the technical competence and organizational skill, the student must see the need to develop conceptual skills, human relation skills, persuasiveness, leadership and influence. This is a difficult task and still in the developmental stage under the broad category of interdisciplinary design.

Specific management training is relegated to later years, since some experience and professional development provides a better basis for the selection of areas of study to prepare for management. The motivation and assessment of needs for decision making which comes with experience makes management education much more effective if it comes at some later time in career development. The popularity of

MBA programs with engineers as their responsibility increases attests to the need. The results have been relatively good for industry and programs tailored for more specific needs are now available, such as engineering management and management science.

The Doctor of Engineering program recognizes that accelerated progress in engineering innovation requires more than the scientific specialist; it requires the skills of a coordinator who can marshal human and material resources, integrate skills of specialists, understand economics and markets, and incorporate a host of intangibles into the engineering decision-making process.

The special features of the Doctor of Engineering program are outlined in Figure 2. In the first phase of the program a student develops technical competence along with the necessary tools for decision making, management, and economic analysis. A one year interdisciplinary team design project is also required to emphasize the need for conceptual skills, human relations, and organizational skills. The project orients the student toward engineering methodology, needs analysis, and the morphology of design and development. The students generally explore areas new to them and include a study of sociological impact.

The second phase of the program is the preparation of a proposal as the first step toward a dissertation. Here the student begins to develop some maturity and insight into the many factors which influence the path of a project from conception to utility. Since he must consider an authentic design problem it is necessary to seek cooperation and support from industry and practicing professionals. The abstraction of such an engineering problem from its industrial context to the academic milieu may destroy some of the essential engineering features. In addition the resources and data required to tackle most authentic design problems are usually inadequate at a university. Hence, the extension of the formal learning process into the professional world of work is a necessary ingredient for a program which is responsive to the present and future needs of industry.

One of the most important features of this phase of the program is the experience the student receives in planning and communicating his ideas in such a way that it is convincing to experienced professionals. In generating support for the project a detailed understanding of the company objectives, the means of implementation, financing, and public opinion are often required.

# UNIVERSITY OF DETROIT

## DOCTOR OF ENGINEERING PROGRAM

### THREE PHASES

**COURSE OF STUDY**

- DECISION MAKING, MANAGEMENT
- PROFESSIONAL AND TECHNICAL SPECIALTY

**PREPARATION OF DISSERTATION PROPOSAL**

AUTHENTIC ENGINEERING PROBLEM

INDUSTRY COOPERATION

**INTERNSHIP**

INDUSTRY AND UNIVERSITY RESOURCES COMBINED

Figure 2

The final phase of the program is the period of internship and dissertation writing. During this period the student moves freely between the company supporting his dissertation and the University, using the resources of both to complete work on his dissertation. He consults frequently with both his faculty advisor and industrial advisor.

Typical examples of internship/dissertation problems are listed in Figure 3.

To develop this type of education calling for interaction at the academia-industry interface places an unusual burden on the faculty. In one sense the faculty must not abdicate their traditional role as constructive critics, pursuing new ideas with an obligation to knowledge and its transmission. On the other hand there must be some continual identification with the requirements of the industrial system, some ability to influence the system, identify and understand the goals of the system, and understand what it takes to implement these goals. Thus, it is clear that the faculty must be scholars and practicing professionals and the University/Industry partnership must be structured to promote this. Industry must commit a part of its resources to the development of faculty; first, by providing the milieu and challenge for full time faculty to exercise their talent, and experience the intangibles of development, design and production. Secondly, the people in industry who can intellectualize their experiences and assess future needs should commit some of their time and expertise to the educational process, teaching, advising and planning with the full time faculty.

In summary, the University/Industry partnership functions through cooperative education broadened to expose and study technical as well as non-technical issues; by industry providing the real world problems and the milieu in which students and traditional faculty work, develop and contribute; and by industry committing some of its capable and experienced manpower to the educational process. The contributions of the University in this partnership should not be overlooked, they are long range and bring the traditional goals of academia closer to industry, hopefully to help understand and respond better to the needs of society.

The University/Industry partnership operates through an industrial advisory board made of influential people from a wide variety of industries. The board is the focal point for all development at the academia-industry interface.

## DOCTORAL INTERNSHIP PROGRAMS

Thermal Modeling of Annealing Lehr for Design and Control
Ford Motor Company

Benefit/Risk Alternatives in Structural Design of Nuclear Power Plants
Detroit Edison Company

Transfer Line Productivity - Design Parameters and Management Policy
Chrysler Corporation

A Simulation Model of Response Characteristics of the Detroit Emergency Medical Service
City of Detroit

Productivity Improvements in the Solid Waste and Vehicle Management Divisions of the City of Detroit
City of Detroit

An Instrument For Designing Van-Type Vehicles to Meet Vision Requirements
Ford Motor Company

A 3-Dimensional Tracking Scheme to Study Gastrointestinal Motility
Michigan Heart Association

The Dynamic and Steady State Analysis of Chemical Processes with an User-Oriented Executive Program
University of Detroit

Figure 3

The success of such an approach to education is difficult to measure. It can only be offered that relative to the size of the Alumni an unusually large number of industrial leaders and corporate executives have gone through the engineering program at the University of Detroit. When asked about the influence their education has had on their success they refer to the cooperative training program and the exposure to humanities, and philosophical principles.

Recent graduates of the Doctor of Engineering program have been sought out by industry and hired at salaries substantially higher than the graduates of research oriented Ph.D. programs.

## References

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